UNIVERSITI PUTRA MALAYSIA

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**DOCTOR OF PHILOSOPHY**
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**By**

**ROUSHON ARA**



**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

**July 2011**

## DEDICATION

***To my parents who always kept praying for me to achieve my goal***

***To my husband 'Dr. S. M. Nurul Amin' and son 'Md. Jahin Zawad', 'AL-Moid Amin'; daughter 'Tazri Amin' who have sacrificed so much for me during this study period***

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

**LARVAL FISH COMPOSITION, DISTRIBUTION AND DIETS IN THE SEAGRASS-MANGROVE ECOSYSTEM OF GELANG PATAH, JOHOR, MALAYSIA**

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**Chairperson: Associate Professor Aziz Arshad, PhD**

**Faculty: Agriculture**

Fish larval composition, spatio-temporal distribution, density, family richness, Shannon-Wiener index and feeding habits were determined by analyzing samples collected from the seagrass-mangrove ecosystem of Gelang Patah, Johor Strait, Peninsular Malaysia between October 2007 and September 2008. Five stations were selected namely Upper estuary (S1), middle estuary (S2) and lower estuary (S3) of Pendas River; seagrass beds (S4) and open seas (S5). Each sampling station was approximately 1 km apart from each other. Fish larvae were collected by subsurface towing of bongo net equipped with a flow meter. In total, 24 families of fish larvae belong to six orders were identified from seagrass-mangrove ecosystem of Gelang Patah, Johor Strait. Similarity matrix and cluster analysis revealed that there are six different families under the order Perciformes.

In total, 24 families were identified from the coastal waters of Gelang Patah, Johor, Peninsular Malaysia. Among them, 14 occurred in upper estuary, 17 in middle

estuary, 16 in lower estuary, 20 in seagrass beds and 16 in open sea. Overall five (Clupeidae, Blenniidae, Terapontidae, Gobiidae and Sillaginidae) were the most dominant in study areas. Shannon-Wiener index varied significantly within monsoon and intermonsoon seasons peaking in the months October-January and May-August. The highest density of larval fishes was recorded at seagrass station (S4) and the spatial variations in larval density were significant ($p < 0.05$) between seagrass and other four sampling sides. None of the diversity indices showed significant among-stations except only family richness was significantly ($p < 0.05$) higher in seagrass beds than upper estuary. Among 24 families, 18 families were found to have correlation either positively or negatively with the water parameters. The highest and significant regression coefficient was observed in Sillaginidae which indicated 72% abundance of Sillaginidae was influenced by the major water parameters and remaining 28% by other factors.

In total, 267 Blenniidae, 401 Clupeidae, 126 Gobiidae and 117 Terapontidae stomachs were examined during the study period. Analyses of prey in the stomachs identified 24 important items (%Rs > 0.05) belonging to six major groups: phytoplankton, zooplankton, algae, plant like matter, debris and unidentified materials. According to the Simple Resultant Index (%Rs), the predominant food item in the stomach of all four families (Blenniidae, Clupeidae, Gobiidae and Terapontidae) was phytoplankton (> 60%). This was followed by zooplankton in Blenniidae (18.24%) and Clupeidae (8.60%). On the other hand, the second diet composition was plant like matter in Gobiidae (14.73%) and Terapontidae (8.02%). Among phytoplankton, *Dacytyloccopsis fasicularis* (26.31%) was large quantity in the stomachs of Bleniidae and this was followed by *Nitzschia baccata* (23.38%). Conversely, *Nitzschia* sp. was

the highest quantity (26.33%) in the stomachs of Clupeidae larvae and subsequently *Dacytyloccopsis fasicularis* (13.56%), *Biddulphia sinensis* (10.51%), *Rhizosolenia araturensis* (8.63%), *Lauderia borealis* (8.06%) and *Fragilaria intermedia* (3.47%). In Gobiidae larvae, Chromophyta (28.30%) was observed as the highest quantity and second highest component was *Nitzschia* sp. (15.97%) and then *Dacytyloccopsis fasicularis* (8.27%). Similarly, Chromophyta (29.12%) was the highest quantity in the stomachs of Terapontidae (Table 6.17). Second and third component was *Nitzschia* sp. (15.95%) and *Dacytyloccopsis fasicularis* (13.80%). Overall, two most dominant phytoplankton (*Dacytyloccopsis fasicularis* and *Nitzschia* sp.) was observed among the four larval families. It is revealed that various food items were found in the stomachs of Bleniidae, Clupeidae, Gobiidae and Terapontidae larvae and remarkable that phytoplankton were more than 60% in the diet composition. Therefore, all studied fish larval families in the study areas are exclusively herbivore.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KOMPOSISI, TABURAN DAN DIET LARVA IKAN PADA EKOSISTEM BAKAU-RUMPUT LAUT DI GELANG PATAH, JOHOR, MALAYSIA**

Oleh

**ROUSHON ARA**

**Julai 2011**

**Chairperson: Profesor Madya Aziz Arshad, PhD**

**Fakulti: Pertanian**

Komposisi larva ikan, taburan kawasan dan masa, kepadatan, kepelbagaian famili, Shannon-Wiener indeks dan habitat pemakanan ditentukan melalui analisis sampel yang diambil dari ekosistem bakau-rumput laut di Gelang Patah, Selat Johor, Semenanjung Malaysia dari Oktober 2007 hingga September 2008. Sebanyak lima stesen yang terpilih dinamakan sebagai 'bahagian atas muara' (S1), 'pertengahan muara' (S2), dan 'bahagian rendah muara' (S3) Sungai Pendas, hamparan rumput laut (S4) dan kawasan laut terbuka (S5). Jarak di antara setiap stesen adalah lebih kurang 1km. Larva ikan disampel di permukaan air dengan menggunakan jaring bongo yang dilengkapi dengan jangka aliran. Secara keseluruhan, 24 famili larva ikan dari enam order telah dikenalpasti dari ekosistem bakau-rumput laut di Gelang Patah, Selat Johor. Persamaan matriks dan analisis kluster menunjukkan terdapat enam famili berbeza di bawah order Perciformes.

Secara keseluruhan, 24 famili telah dikenalpasti dari kawasan perairan Gelang Patah, Selat Johor, Semenanjung Malaysia. Di antara 24 famili tersebut, 14 famili terdapat di kawasan 'bahagian atas muara', 17 di kawasan 'pertengahan muara', 16 di kawasan 'bahagian rendah muara', 20 di kawasan hamparan rumput laut dan 16 di kawasan laut terbuka. Clupeidae, Blenniidae, Terapontidae, Gobiidae and Sillaginidae merupakan famili yang paling dominan di kawasan kajian. Indeks Shannon-Wiener menunjukkan perbezaan yang signifikan di antara kemuncak musim monsun dan antara monsun yang berlaku pada bulan Oktober-Januari dan Mei-Ogos. Kepadatan larva ikan yang tertinggi direkodkan di kawasan hamparan rumput laut (S4) dan variasi taburan kawasan untuk kepadatan larva ikan adalah signifikan ($p < 0.05$) di antara kawasan rumput laut dengan 4 kawasan kajian yang lain. Indeks diversiti tidak menunjukkan perbezaan yang signifikan di antara stesen, kecuali kepelbagaian famili yang lebih tinggi secara signifikan ($p < 0.05$) di kawasan hamparan rumput laut berbanding bahagian atas muara. Di antara 24 famili, 18 famili telah didapati mempunyai korelasi sama ada positif atau negatif dengan parameter air. Regresi tertinggi dan pekali yang signifikan telah diperhatikan dalam Sillaginidae yang menunjukkan sebanyak 72% Sillaginidae dipengaruhi oleh parameter air utama dan baki 28% dipengaruhi oleh faktor lain.

Secara keseluruhan, struktur perut larva untuk 267 Blenniidae, 401 Clupeidae, 126 Gobiidae and 117 Terapontidae telah dianalisa sepanjang tempoh kajian. Analisa kandungan perut menunjukkan terdapat 24 item penting (%Rs > 0.05) yang tergolong kepada enam kumpulan: fitoplankton, zooplankton, alga, bahan berbentuk tumbuhan, debris dan bahan yang tidak dikenalpasti. Berdasarkan Simple Resultant Index (%Rs), makanan predominan di dalam perut kesemua 4 famili (Blenniidae, Clupeidae,

Gobiidae and Terapontidae) adalah fitoplankton (> 60%), diikuti oleh zooplankton pada Blenniidae (18.24%) dan Clupeidae (8.60%). Komposisi diet yang kedua di dalam Gobiidae dan Terapontidae merupakan bahan berbentuk tumbuhan iaitu sebanyak (14.73%) dan (8.02%). *Dacytyloccopsis fasicularis* merupakan fitoplankton yang mempunyai kuantiti terbesar di dalam perut Bleniidae iaitu sebanyak (26.31%) diikuti oleh *Nitzschia baccata* (23.38%). Manakala *Nitzschia* sp. mencatatkan kuantiti tertinggi (26.33%) di dalam perut larva Clupeidae dan ini diikuti oleh *Dacytyloccopsis fasicularis* (13.56%), *Biddulphia sinensis* (10.51%), *Rhizosolenia araturensis* (8.63%), *Lauderia borealis* (8.06%) dan *Fragilaria intermedia* (3.47%). Chromophyta mencatatkan kuantiti tertinggi (28.30%) pada larva Gobiidae manakala komponen kedua tertinggi pula adalah *Nitzschia* sp. (15.97%) dan *Dacytyloccopsis fasicularis* (8.27%). Chromophyta mencatatkan kuantiti tertinggi (29.12%) di dalam Terapontidae (Jadual 6.17). Komponen kedua dan ketiga tertinggi adalah merupakan *Nitzschia* sp. (15.95%) dan *Dacytyloccopsis fasicularis* (13.80%). Secara keseluruhan, dua fitoplankton yang paling dominan (*Dacytyloccopsis fasicularis* dan *Nitzschia* sp.) telah dikenalpasti di kalangan empat famili larva. Kajian menunjukkan terdapat pelbagai variasi makanan ditemui di dalam perut larva Bleniidae, Clupeidae, Gobiidae dan Terapontidae termasuklah fitoplankton yang telah mencatatkan lebih dari 60% daripada komposisi diet keseluruhan. Oleh yang demikian, dapat dirumuskan yang kesemua larva ikan yang dikaji di kawasan kajian merupakan herbivor.

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I certify that a Thesis Examination Committee has met on 7th July to conduct the final examination of Roushon Ara on her thesis entitled "Fish Larval Composition, Distribution and Diets in the Seagrass-Mangrove Ecosystem of Gelang Patah, Johor Strait, Peninsular Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Examination Committee were as follow:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Date:

## DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

**ROUSHON ARA**

Date: 7 July 2011

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